

# Estimating Mina Jaya Niaga 11 Ship Repair (In Man-hour) using Work Breakdown Structure

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**Abstract**—Mina Jaya Niaga fishing vessel procurement project were unsuccessful. There are 34 planned to be built but only 14 were able to be finished. Through the Minister of Maritime Affairs and Fisheries, the government intended to use the vessels again. Based on the recent survey, Mina Jaya Niaga 11 is one of the five vessels which still worthy to be repaired. The government intended to use the vessel because there is still a potency of tuna fishing in Indonesia. The demand for tuna in the market is grewed as Tuna is one of the high-value marine commodity and popular in the world. An economic feasibility study is likely to be conducted to analyze whether the vessel is feasible or not. The capital expenditure, one of the components to be used for feasibility study needed to be examined. The capital expenditure in this project is the estimation cost of the ship refurbishment. Work breakdown structure in order to categorize the vessel repairing aspect is used on this paper to estimating the vessel repair cost. The result of the repair cost is only the shipyard cost and the total man-hour is about 7910 hour.

**Keywords**—Capital Expenditure, Feasibility Study, Mina Jaya Niaga, Ship Repair, Work Breakdown Structure.

## I. INTRODUCTION

**M**INA Jaya Niaga 11 fishing vessel is one of the 31 vessel which originated comes from Mina Jaya Niaga project procurement. The program was intended to strengthen Indonesia's maritime sector. Through this project, on 1996, Indonesia government bought 31 tuna longliner shipset from Spain. The shipsets were planned to be assembled and finished on PT. Industri Kapal Indonesia (PT. IKI) shipyard located in Makassar. Unfortunately, due to the monetary crisis on 1998, these projects were unfinished. From 31 fishing vessel only 16 were able to be finished, including Mina Jaya Niaga 11 fishing vessel.

Based on the survey conducted by PT. IKI and NASDEC team there are 5 vessels which classified worthy to be repair because the ship is still in good condition and has not undergo severe damage. Mina Jaya 11 are among ship which is still worthy to be repair. The surveys are under supervision from the Minister of Fisheries and Maritime Affairs. The Minister intended to re-operate again the vessel because they want to save the Mina Jaya asset before all of the vessels having a lot of damage and cannot be re-operating again. The 5 vessel then will be repair and re-operate again. Meanwhile the other vessel will be scrapped. The action made to the assets will also help

PT. IKI clearing the area since all of the vessels are now covering the productive area of PT. IKI.

In order to be operable, the vessel must undergo several repairs. To acquire the estimate repair list, the vessel will be divided into several categories according to the work breakdown structure. The estimate list of the repair will become reference to forecast the ship repair cost estimation. The repair cost estimation is important as it will become the capital expenditure of further feasibility analysis.

## II. DATA COLLECTION

Before conducting estimating on ship repair, the ship particular data should be obtained.

### A. Ship Particular

Table 1.  
Ship Particular

General Information	
Ship Name	Mina Jaya Niaga 11
Type	Long Liner
Hull Material	Steel
LOA	50.7 m
LPP	43 m
B	8.4 m
H	3.6 m
D	3.2 m
GT	512 ton
Machinery	
Main Engine	1 x 800 kW
Aux. Engine	2 x 415 HP
Altenators	380 V, 50 Hz, 256 kW/486 A

### B. Data Processing

All of the machinery data from the ship particular then will be examined and categorized according to the system. For estimating the repair cost, each of the machinery will be listed one by one and then determine the estimating man-hour. Then the total cost is taken from man-hour estimation times with the rate of working labor.

## III. ESTIMATION PROCESS

### A. Work Breakdown Structure

Work breakdown structure is a deliverable-oriented categorizing of the project components that organizes and defines the total scope of the whole project [1]. It is often used

in a project management strategy to make an overview of the project. Through WBS a project will be grouped into several categories which will ease to define the project section. The WBS is seldom used to develop a common understanding of project scope. Project will be breakdown into several categories and each descending of categories will shows an increasingly detailed description of the project deliverables.

One of the benefits of breaking a project into WBS is ease the user to estimating cost or budgeting. The cost of each work in the WBS can be determined therefore it may shows the total cost which the project needed. By doing so, the cash balance of the project may also be adjusted and may avoided cost overruns because the total cost of the whole project is already captured [2].

In shipping industry, there is widely used of WBS in estimating new ship building process and repairing process [3]. To ease estimating the cost of new ship building, a breakdown of each system is derived. The ship is a complex building consists of many system, by breaking down it into several WBS it will ease to estimate the cost of the project. For example, propulsion system and it can be breakdown into main engine part which consists of main engine cooling system, main engine fuel pump system, main engine start system, etc [4].

### B. Shipyard Cost

Shipyards used to divide the cost of estimation into material and labor cost. Material estimates are provided as costs based on the ship particular; however labor estimates are showed in labor hours. The labor estimates showed in man-hours to maintain confidentiality of shipyard labor rates [4].

### C. Mina Jaya Niaga 11 Work Breakdown Structure for Repairing

Don Butler through the book "Guide to Ship Repair Estimates (In Man-hours)" has estimating a ship repair in man-hours. From the book the labor cost from the repairing of the vessel can be obtained. The vessel repair estimation excludes the material cost used to repair the ship. If the project is conducted on country with excessive heat and high humidity the output of the worker will fall for about 50 % [5]. Based on the book, the WBS is shown in figure 1.

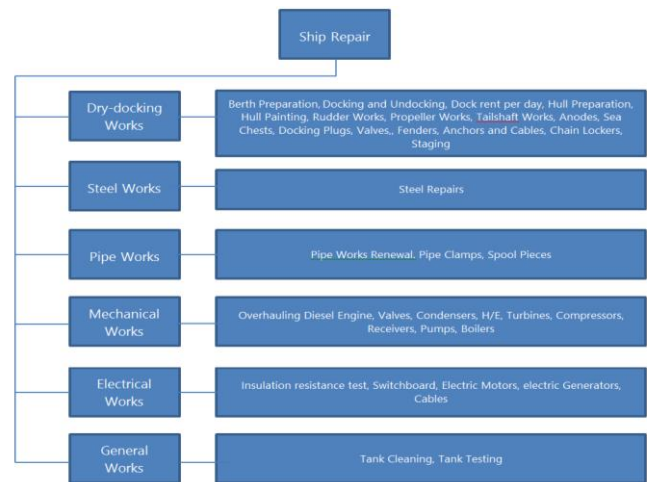


Figure 1. Ship Repair Breakdown Structure According to "Guide to Ship Repair Estimates (In Man-hours)".

Figure 1 shows the hierarchy of work breakdown structure of Mina Jaya Niaga 11. In dry-docking works, it consists of the estimate man-hour of berth preparation until docking and undocking the ship. It is also include the work which conducted below the waterline such as rudder works, propeller works, tail-shaft works, changing of anodes, cleaning of sea chest, valves, and fenders, cleaning of anchors and cables, and chain lockers.

The second is steel works, in this category, NDT surveys should be conducted to examine whether the ship need a re-plating or not. After knowing the need of re-plating, the man-hour can be obtained.

The third is pipe works. The main tasks in pipe works are removal of existing pipe and disposal ashore. Fabrication of new pipe in workshop to pattern of existing complete with new flanges, delivery on board of new pipe and installation in place with the supply of new soft jointing and standard material fastenings. Re-fitment of original clamps with new standard material and fastenings.

Next is mechanical works. Mechanical works are examined and repair the machinery on board the vessel. The work is carried out one by one according to the machinery characteristic. For example, main engine work include disconnecting, removing, cleaning, and then put it back again of cylinder head, piston gudgeon pin etc. It also conduct top overhaul which is disconnect and remove one pair of crankcase doors, disconnect bottom end bearing fastenings. Disconnect and remove cylinder head, withdraw piston, remove piston rings, clean, calibrate and reassemble as before using all owner's supplied spares. I also check all of the bearing and valves of the engine. The category is based on kW per machinery.

The fifth is electrical work. The electrical work is conducted by check all of the cable on board the ship, switchboard. It also check, cleaning, and repair the electric motor and electric generator.

The last of the category is tank cleaning and tank testing. The man-hour is showing how much the man-hour to remove

the man-holes, removing sludge, dirt and debris cubic meter, hand cleaning of bilge area inside tanks per 10 square meter and hand-scraping of internal steel areas per 10 square meter. It also conducting tank testing by low pressure compressed air per tonne capacity and tank testing by filling with sea water, per tonne capacity on several tanks.

#### IV. RESULT AND DISCUSSION

After list all of the machinery and estimating it throughout the man-hour, the man-hour can be obtained by times it with the labor rate hour. Figure 2 are showing the result of each category.

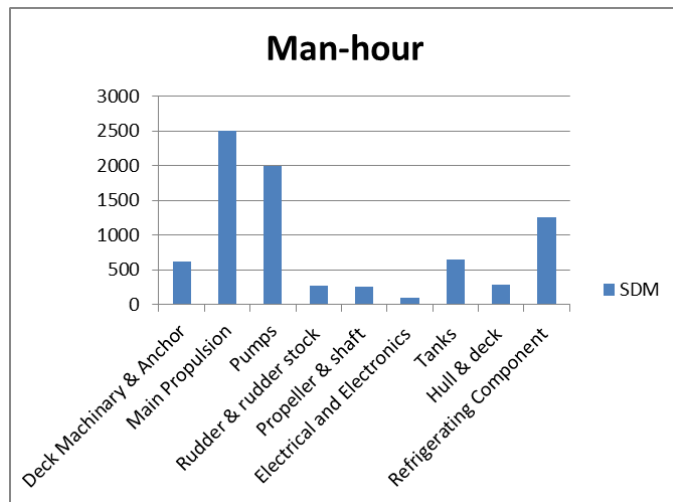


Figure 2. Ship Repair Estimation in Man-Hour

Figure 2 are showing the result of man-hour estimation of Mina Jaya Niaga 11. The total man-hour needed is about 7910 hour based on the several components. As it can be seen the most repairing aspect which has the most man-hour is the machinery. Main engine and its propulsion took the highest part of man-hour followed by pumps and refrigerating components. The rest is about equal for about 500 man-hour.

The WBS according to "Guide to Ship Repair Estimates (In Man-hours)" is already categorized. But according to the data of the ship and adjustment there are some part which is needed to be separate and to be written in detail. There are also some of the components which are not stated in the book because the ship only mentions the ship component in general. The machinery such as fishing machinery is not mention in the book, so expert judgments are needed to complete the ship repair estimation cost. However, the most part of the repair cost are already estimated.

#### V. CONCLUSION AND SUGGESTION

The book "Guide to Ship Repair Estimates (In Man-hours)" already categorized work breakdown structure of the repair components. But, the book is only general and there are some parts of the ship which not mention in the book.

The estimation is only the shipyard cost estimation, there is material cost such as paint, electrode, new machinery, which is

needed to be added before continuing further to capital expenditure for feasibility analysis. Moreover, it is only in man-hour because the price cost is fluctuating over the times. To make it in actual price, the man-hour must be times with the cost of the labor per hour.

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